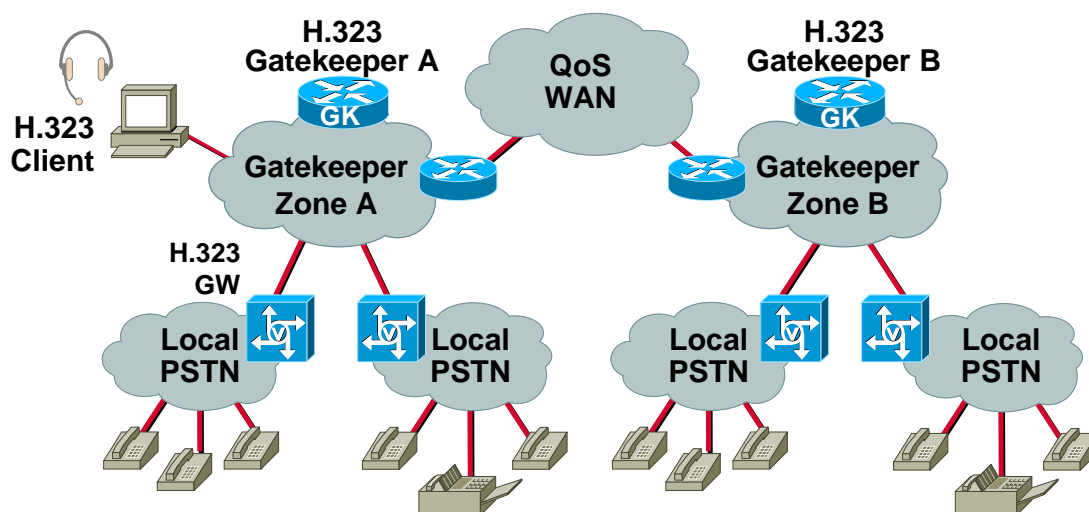


Topics

- **Brief Introduction to H.323 and Applications**
- **Sample Network Scenario**
- **GK Performance**
- **Alternate GK Discussion**
- **Q & A**

Example: H.323 Zones



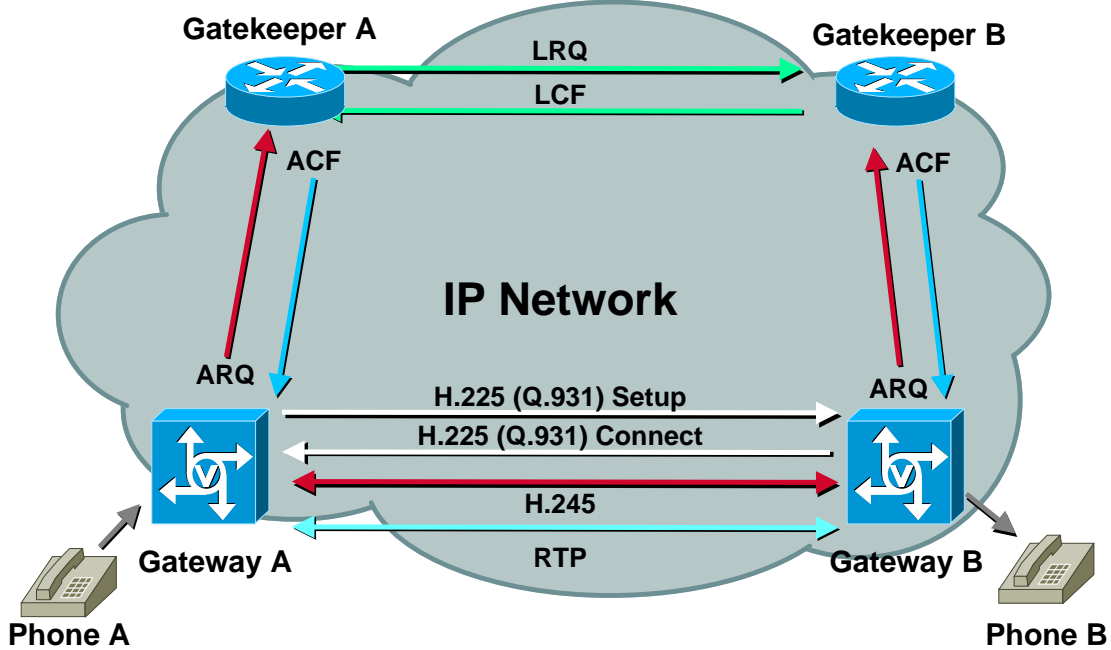
Gatekeeper Mandatory Services

- **Address translation**
Translates H.323 aliases or E.164 addresses into IP transport addresses (e.g. 10.1.1.1 port 1720)
- **Admissions control**
Authorizes access to the H.323 network
- **Bandwidth control**
Manages endpoint bandwidth requirements
- **Zone management**
Provides the above functions to all terminals, gateways, and MCUs that register to it

RAS Messages

- **GRQ/GCF/GRJ (discovery)**
Unicast—Multicast, find a gatekeeper
- **RRQ/RCF/RRJ (registration)**
Endpoint alias/IP address binding, endpoint authentication
- **ARQ/ACF/ARJ (admission)**
Destination address resolution, call routing
- **LRQ/LCF/LRJ (location)**
Intergatekeeper communication
- **DRQ/DCF/DRJ (disconnect)**
Get rid of call state

H.323 Message Exchange



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Applications—Single-Stage Dial

Enterprise Application:



Inter-PBX Trunk Replacement
(Without Features)



Service Provider Application:



Wholesale Minute Providers



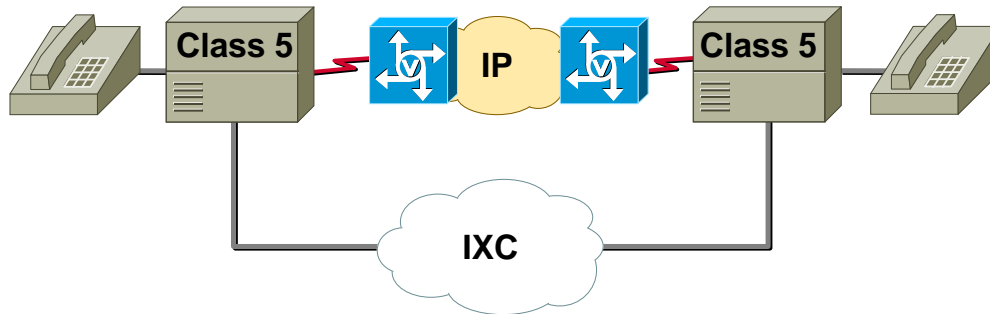
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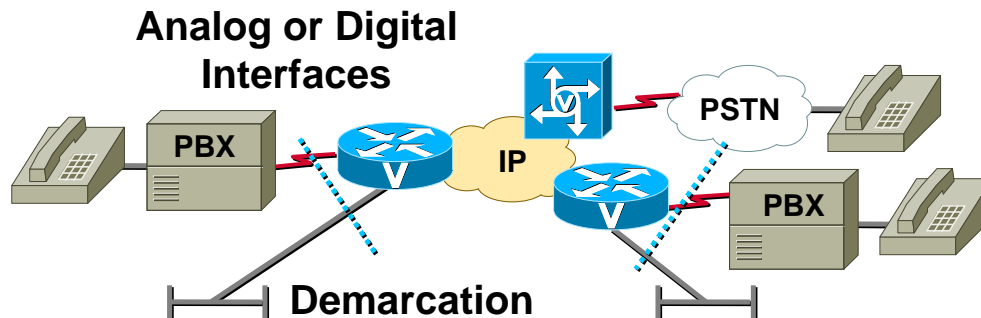
Applications—Two-Stage Dial



- **Service Provider Application:**

The customer has selected traditional IXC, but dials a number to get access to the bypass provider's network. After authenticating can make the call to the ultimate destination

Enterprise Managed Service



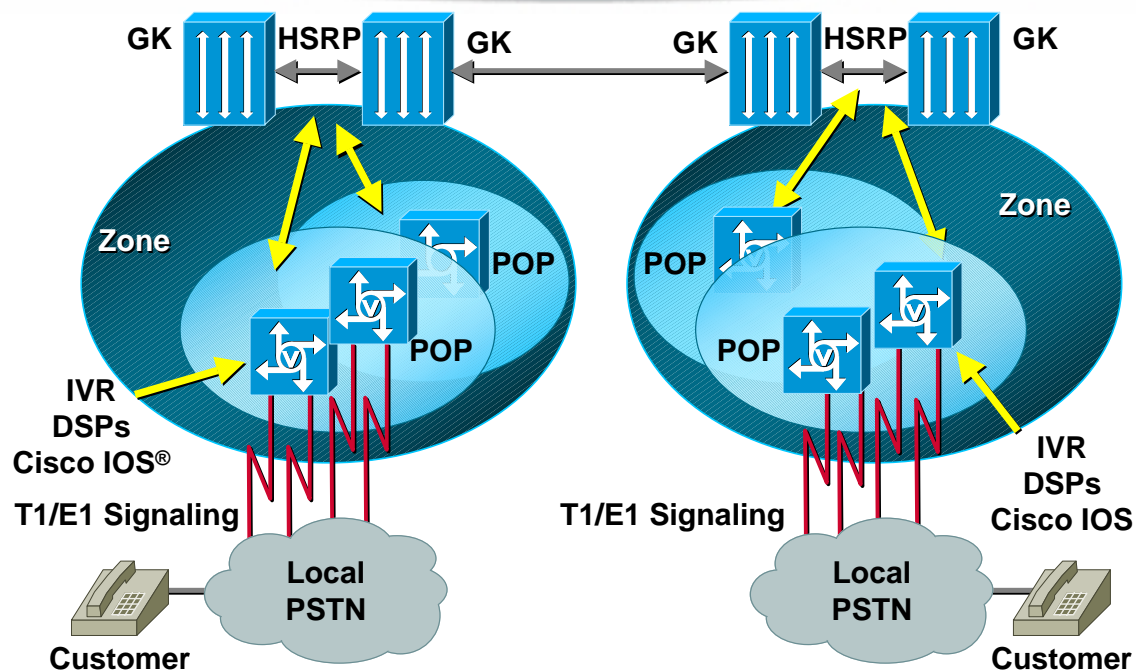
- **Service provider application:**

The Enterprise customer can choose to purchase long distance service, and/or an intracompany VPN service

Topics

- Brief Introduction to H.323 and Applications
- **Sample Network Scenario**
- GK Performance
- Alternate GK Discussion
- Q & A

Anatomy of an H.323 Network



Network Dimensioning— How Assumptions Affect Design

	Area of Impact	
	WAN Bandwidth	Ports GW/GK
Silence suppression Cannot be applied to non-voice applications (e.g. fax) Percent reduction in per-call bandwidth will vary by application (e.g., Music on Hold for call center—will not save any BW)	X	
CODEC type Bandwidth per call varies by CODEC type (e.g., G.711 bandwidth > 64 kbps)	X	
Average Holding Time (AHT) AHT varies by application, user type, and even market (e.g., fax has shorter AHT than voice)	X	X
Header compression Reduces bandwidth per call for low-speed links	X	

POP Sizing—Number Of GWs



Assumptions:

- POP must service X BHCA
- 3 Minute hold times (HT)
- AS5300 GWs can handle up to 2 calls per second
- 120* ports per AS5300

* Depends on T1 or E1 and signaling type

Calculating number of GWs:

- Calls/DS0 per hour
 = (60 min/hour) / (HT)
 = 60/3
 = **20 BHCA/DS0**
- BHCA capacity of AS5300
 = (DS0/GW) * (BHCA/DS0)
 = 120 * 20
 = **2,400 BHCA/GW (0.67 calls/sec)**
- # AS5300 GWs needed
 = (POP BHCA)/(BHCA/GW)
 = **X / 2400 AS5300 needed**

POP Sizing—WAN Bandwidth



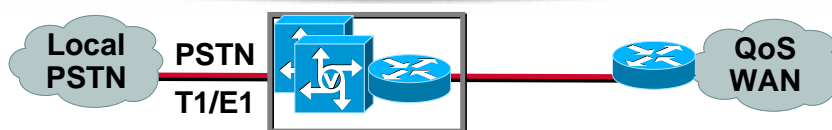
Assumptions:

- Voice calls
- 120 ports/AS5300
Depends on T1/E1 and signaling type
- Voice activity detection 30% efficiency on bandwidth for standard voice calls at T1/E1 levels and up
- G.729 CODEC used
- 60 byte packets + link layer (no header compression)

WAN Bandwidth/GW:

- Bandwidth per call
 $66 \text{ bytes} * 8 \text{ bits/byte} * 50 \text{ pps}$
= 26.4 kbps
- Total WAN bandwidth/GW
 $26.4 \text{ kbps} * 120 (96^*) \text{ calls/GW}$
= 3.17 Mbps (2.53 Mbps*)
- Assume 30% VAD efficiency
 $2.53 \text{ Mbps} * 70\%$
= 2.22 Mbps (1.77 Mbps*)

POP WAN Sizing With CRTP



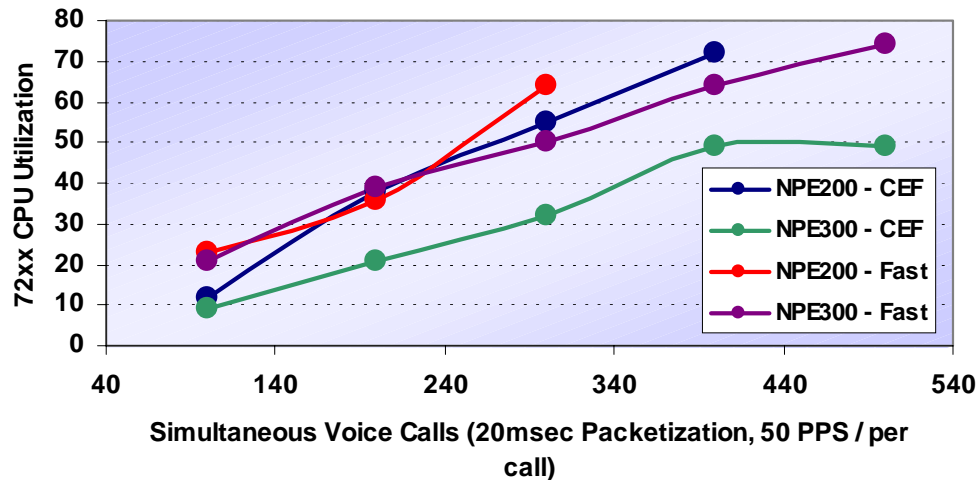
CRTP:

- Performed on WAN backhaul router (e.g. 3660/7200)
- Reduces IP header from 40 bytes to 2-4 bytes much of the time
- Hop-By-Hop
- Fast/CEF switched cRTP

WAN Bandwidth:

- Bandwidth per call (G.729 CODEC):
= 12 kbps
- Total WAN bandwidth/GW
 $12 \text{ kbps} * 120 (96^*) \text{ calls}$
= 1.44 Mbps (1.15 Mbps*)
- Assume 30% VAD efficiency
= 1.34 Mbps < 1 T1/E1

cRTP Performance 12.1(2)T



Topics

- Brief Introduction to H.323 and Applications
- Sample Network Scenario
- **GK Performance**
- Alternate GK Discussion
- Q & A

GK Zone Sizing

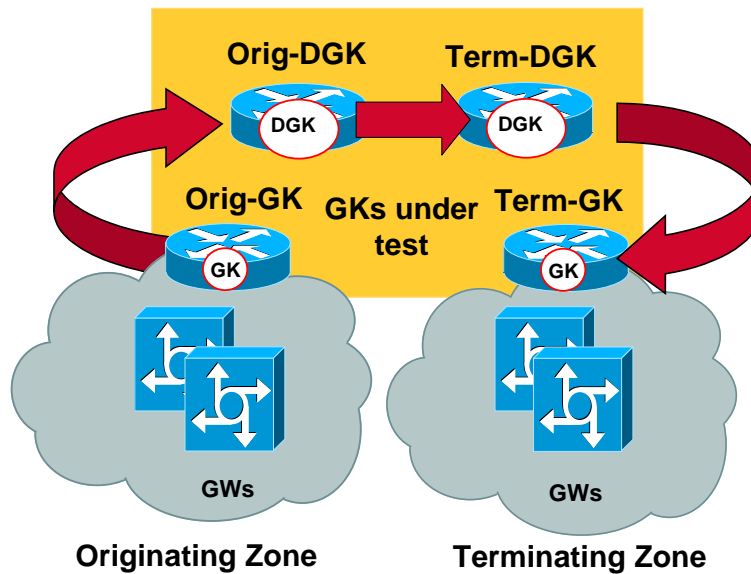
Number of Busy Hour Call Attempts (BHCA) per GK depends upon:

- **GK Platform**
- **Fault-tolerance features**
- **Number of registered endpoints**
- **Dial plan complexity**
- **Average hold times**

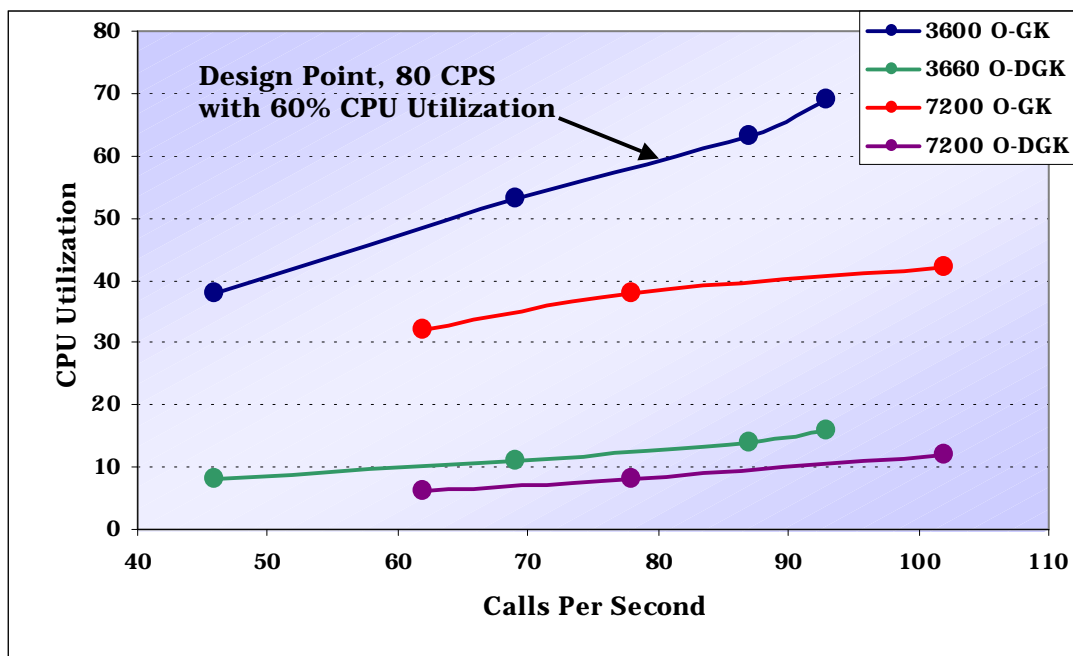
Measuring GK Performance

- **Call success rate**
99.9% target
- **CPU utilization**
60% five minute CPU average
Accommodate potential CPU bursting to maintain high call success rate

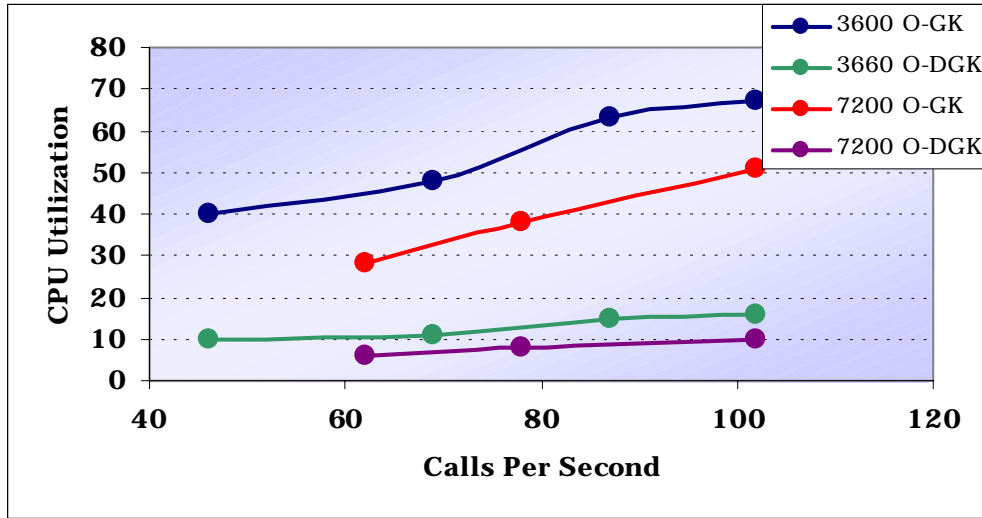
Performance Test—Bed



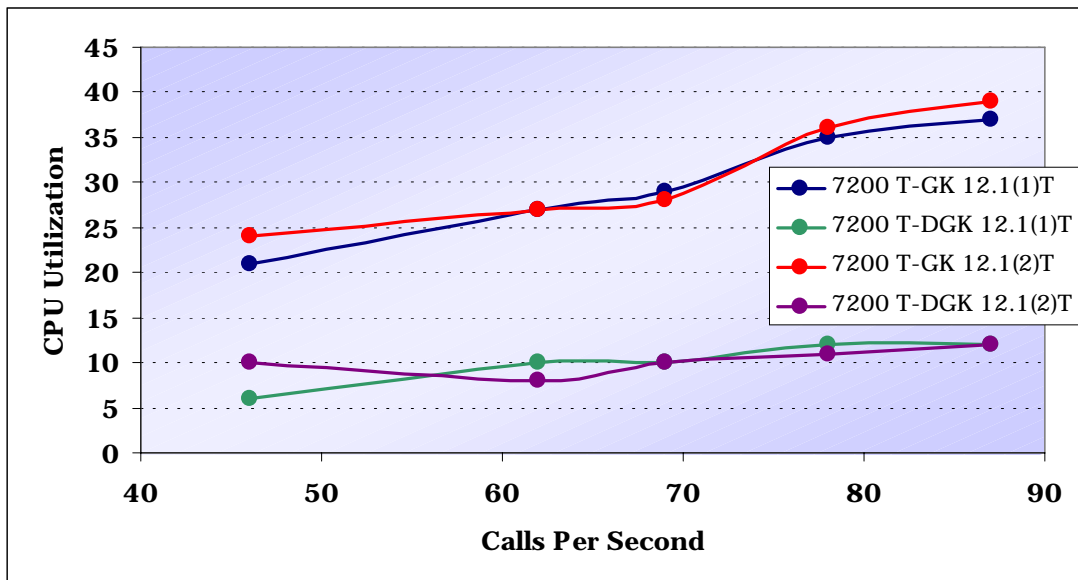
12.1(1)T Origination GK Performance



12.1(2)T Origination GK Performance

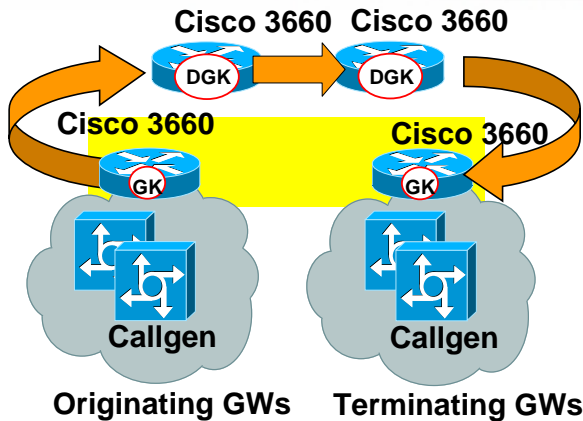


Terminating GK Performance



Directory GK to Regular GK Ratio Is About 1:4 Based on These Results

Sample Design with Cisco 3660 GK



Cisco 3660 showed **80 cps = 288,000 BHCA**

Test Conditions:

- 10 zones on local GKs
- 540 zone prefixes on terminating GK
- 20 registered gateways
- 10 second hold times
- Cisco IOS 12.1(1)T

To reach this 280,000 BHCA, large number of GWs with 120 ports will be needed. For the following results we reduced the Hold Time to 10 sec. In order to get a high call volume. **Recognize that the higher number of GWs will add the additional RAS burden.**

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GK Zone Sizing Arithmetic for Cisco 3660

GWs/GK?



GWs/GK?

Number of AS5300 GWs per 3660 GK:

Straight Calculation

$$\begin{aligned}
 &= \text{GK BHCA} / \text{GW BHCA} \\
 &= 288,000 / 2400 \text{ (1840*)} \\
 &= 120 \text{ GWs/GK (157 GWs/GK*)} \\
 &\text{* for T1 PRI}
 \end{aligned}$$

Leaving headroom for registrations (RRQs) and longer hold times (IRRs)

Recommend no greater than 100 GWs/GK

Number of 3660 GKs/ Network:

Depends if network originates and/or terminates minutes

Assuming that all calls are Interzone calls and we both originate and terminate:

$$\begin{aligned}
 &= (\text{Total GWs}) / 100 \\
 &= [(X / 2400) * 2] / 100 \text{ GKs}
 \end{aligned}$$

Double this value for HSRP or ALTGK fault tolerance

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Sizing Exercise

Given:

- 1,000,000 BHCA network
- Average hold time = 3 minutes
- DS0s per GW will depend on signaling type

	T1 PRI	T1 CAS	E1 PRI	E1/R2
GW BHCA	1840	1920	2400	2400
# GWs	544	521	417	417
(orig&term)	(1088)	(1042)	(834)	(834)
# Zones	6	6	5	5
	(12)	(12)	(10)	(10)

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Sample Network Characteristics

- 1,000,000 Busy Hour Call Attempts (BHCA) spread across various POPs
- Voice and fax calls
- Initial deployment in NY, Chicago, and LA
- Hopoff zone to handle non-locally serviced traffic
- Deploy the rest of the POPs within a year
- 720x routers for backhaul

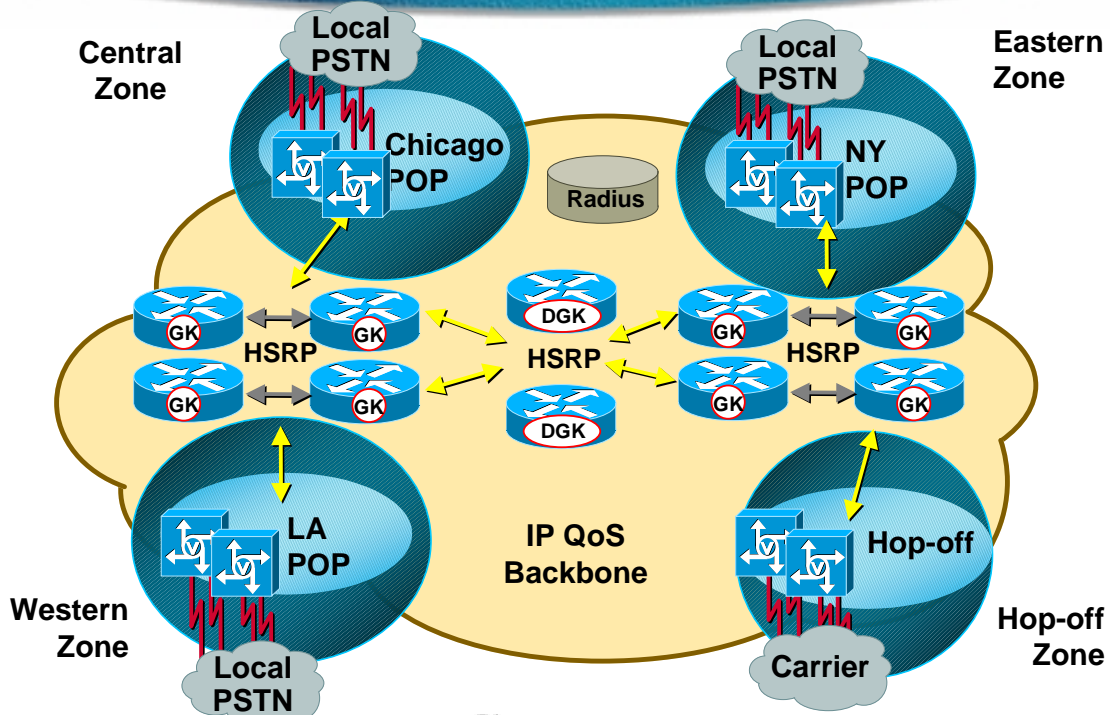
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Initial Network (Four POPs)



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Directory Gatekeeper

- Introduced in 12.0(3)T
- Creates a hierarchical architecture of GKs
- Eliminates fully-meshed gatekeeper configuration
- Simplifies dial-plan management
- DGKs require approximately one-quarter of the CPU used on local GKs per call

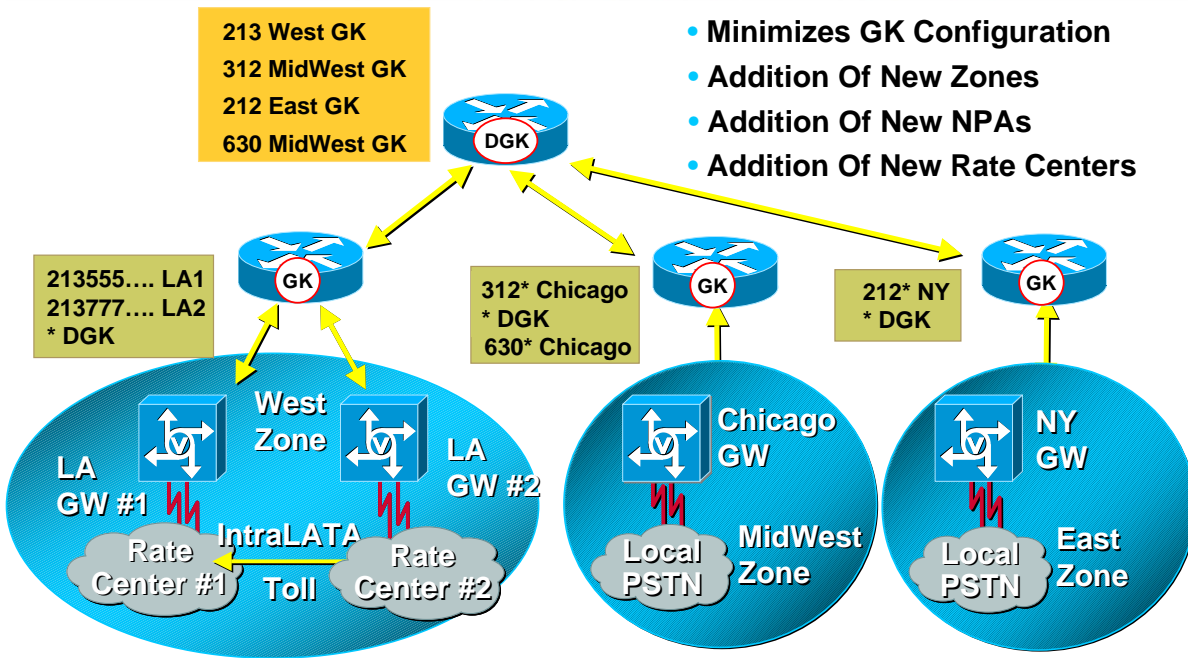
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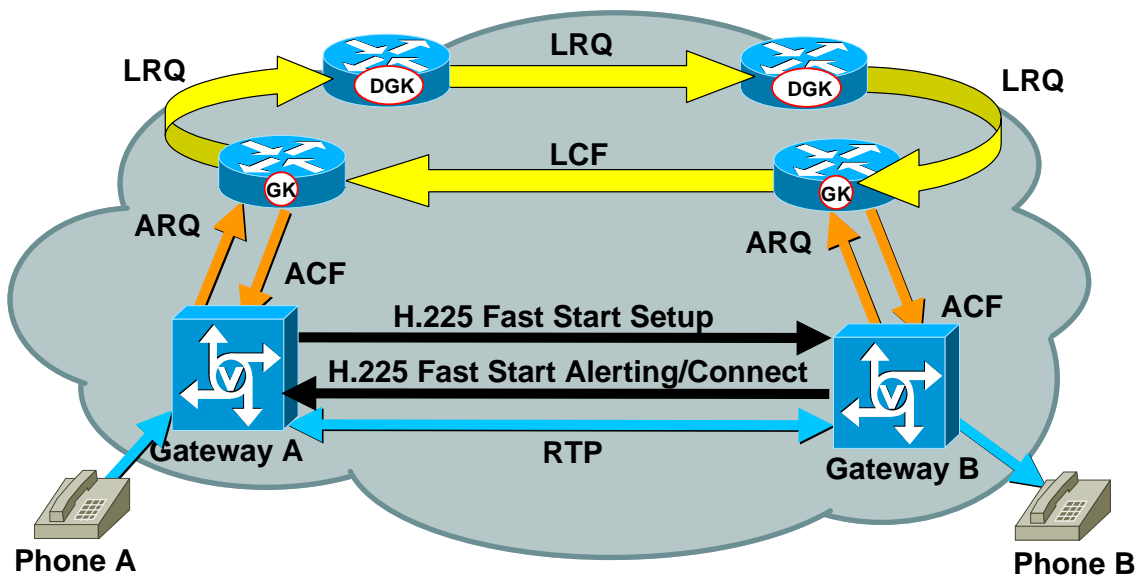
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DGK Dial Plan Management

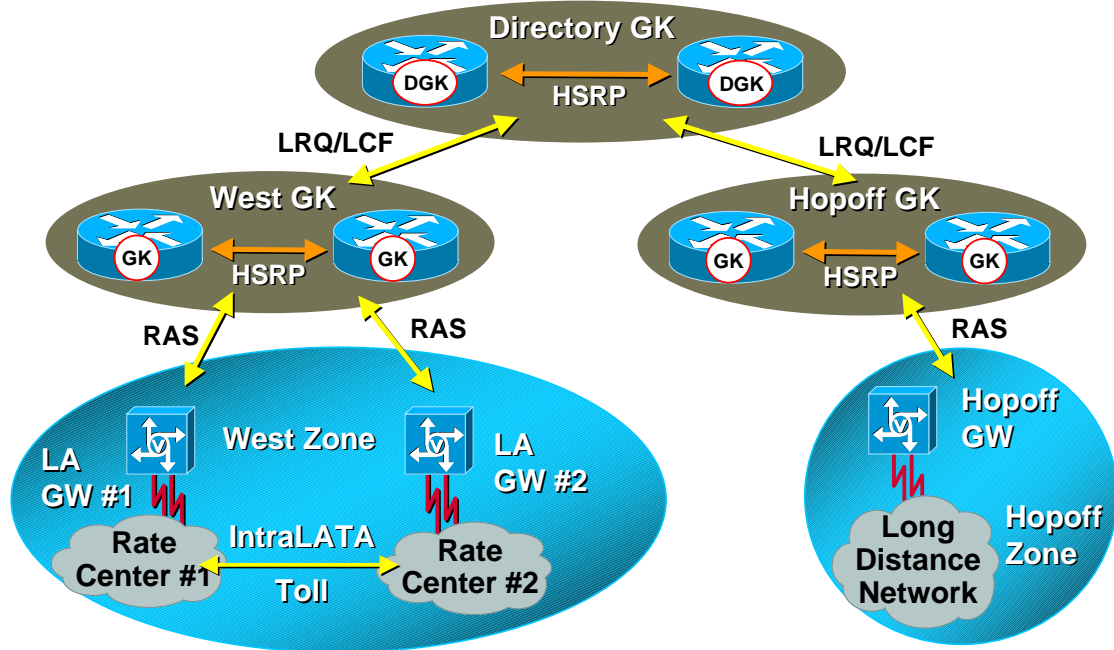


Cisco IOS 12.1(1)T H.323 Call Flow



Limit of Five Recursive Lrqs

Detailed Network Diagram



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GW Config—LA1

```
hostname lal-gw.west.acme.com
!
aaa new-model
aaa authentication login default radius
aaa accounting connection h323 start-stop radius
!
isdn switch-type primary-5ess
!
controller T1 0
 framing esf
 clock source line primary
 linecode b8zs
 pri-group timeslots 1-24
!
dial-peer voice 1 voip
 destination-pattern 1.....
 session target ras
 precedence 5
Repeat until 9.....
!
dial-peer voice 213555 pots
 destination-pattern 213555....
 application clid_authn_collect
 port 0:D
 prefix 555
!
Repeat for other NPA-NXXs served
```

```
gateway
!
interface Loopback0
 ip address 10.10.250.1 255.255.255.0
 no ip directed-broadcast
 h323-gateway voip interface
 h323-gateway voip id gk.west.acme.com ipaddr
 10.10.254.10 1719
 h323-gateway voip h323-id lal-gw.west.acme.com
 h323-gateway voip tech-prefix 1#
```

```
!
interface Ethernet0
 ip address 10.10.254.5 255.255.255.0
!
interface Serial10:23
 isdn switch-type primary-5ess
 isdn incoming-voice modem
```

```
!
radius-server host 10.1.11.11 auth-port 1645
 acct-port 1646
 radius-server key testing123
```

```
lal-gw.west.acme.com#show gateway
Gateway lal-gw.west.acme.com is
 registered to Gatekeeper gk.west.acme.com
```

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GW Config—LA2

```
hostname la2-gw.west.acme.com
!
aaa new-model
aaa authentication login default radius
aaa accounting connection h323 start-stop radius
!
isdn switch-type primary-5ess
!
controller T1 0
 framing esf
 clock source line primary
 linecode b8zs
 pri-group timeslots 1-24
!
dial-peer voice 1 voip
 destination-pattern 2.....
 session target ras
 precedence 5
Repeat until 9.....
!
dial-peer voice 213777 pots
 destination-pattern 213777....
 application clid_authen_collect
 port 0:D
 prefix 777
!
Repeat for other NPA-NXXs served
```

```
gateway
!
interface Loopback0
 ip address 10.10.250.2 255.255.255.0
 no ip directed-broadcast
 h323-gateway voip interface
 h323-gateway voip id gk.west.acme.com ipaddr 10.10.254.10 1719
 h323-gateway voip h323-id la2-gw.west.acme.com
 h323-gateway voip tech-prefix 1#
!
interface Ethernet0
 ip address 10.10.254.6 255.255.255.0
!
interface Serial0:23
 isdn switch-type primary-5ess
 isdn incoming-voice modem
!
radius-server host 10.1.11.11 auth-port 1645
 acct-port 1646
radius-server key testing123

la2-gw.west.acme.com# show gateway
Gateway la2-gw.west.acme.com is
registered to Gatekeeper gk.west.acme.com
```

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Gateway Selection (GK CLI)

- Calls assigned to GWs based on prefix and priority
- GWs with same priority are assigned randomly
- Priority value is between 0–10
 - Default value is 5
 - Priority 0 do not give any calls to specified GW
 - Priority 10 always try specified GW first (if available)

```
gatekeeper
 zone local gk.west acme.com 10.10.253.10
 zone prefix gk.west 213555* gw-priority 10 la1-gw
 zone prefix gk.west 213777* gw-priority 10 la2-gw
 zone prefix gk.west 310*
```

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GK Config—LA

```
hostname gk.west.acme.com
!
interface Ethernet0/0
 ip address 10.10.254.4 255.255.255.0
 standby 1 priority 90
 standby 1 ip 10.10.254.10
!
gatekeeper
zone local gk.west.acme.com acme.com 10.10.254.10
zone remote gk.directory.acme.com acme.com 10.10.250.10 1719
zone prefix gk.west.acme.com 213555* gw-priority 10 la1-gw
zone prefix gk.west.acme.com 213777* gw-priority 10 la2-gw
zone prefix gk.west.acme.com 310*
zone prefix gk.directory.acme.com *
gw-type-prefix 1#* default-technology
no shutdown
```

GK Show Commands—West

```
gk.west.acme.com#show gate gw-type-prefix
GATEWAY TYPE PREFIX TABLE
=====
Zone gk.west prefix 213555* priority gateway list(s):
Priority 10:
 10.10.250.1:1720 la1-gw
Priority 5:
 10.10.250.2:1720 la2-gw
Zone gk.west prefix 213777* priority gateway list(s):
Priority 10:
 10.10.250.2:1720 la2-gw
Priority 5:
 10.10.250.1:1720 la1-gw
Zone gk.west prefix 310* priority gateway list(s):
Priority 5:
 10.10.250.1:1720 la1-gw
 10.10.250.2:1720 la2-gw
```

GK Show Commands—West

```
gk.west.acme.com#show gatekeeper endpoints
                        GATEKEEPER ENDPOINT REGISTRATION
                        =====
CallSignalAddr  Port  RASSignalAddr  Port  Zone Name  Type  F
-----
10.10.250.1     1720  10.10.250.1    4461  gk.west    VOIP-GW
      H323-ID: la1-gw
10.10.250.2     1720  10.10.250.2    4462  gk.west    VOIP-GW
      H323-ID: la2-gw

gk.west.acme.com#show gatekeeper zone prefix
                        ZONE PREFIX TABLE
                        =====
GK-NAME          E164-PREFIX
-----
gk.west          213555*
gk.west          213777*
gk.west          310*
gk.directory    *
```

GK Config—Hopoff

```
hostname gk.hopoff.acme.com
!
interface Ethernet0/0
 ip address 10.10.253.4 255.255.255.0
 standby 1 priority 90
 standby 1 ip 10.10.253.10
!
gatekeeper
 zone local gk.hopoff.acme.com acme.com 10.10.253.10
 zone remote gk.directory.acme.com acme.com 10.10.250.10 1719
 zone prefix gk.hopoff.acme.com *
 gw-type-prefix 1#* default-technology
 no shutdown
```

GK Show Commands—Hopoff

```
gk.hopoff.acme.com#show gatekeeper endpoints
      GATEKEEPER ENDPOINT REGISTRATION
      =====
CallSignalAddr  Port  RASignalAddr  Port  Zone Name      Type  F
-----
10.10.248.1     1720  10.10.248.1   3361  gk.hopoff.acme.co  VOIP-GW
      H323-ID: gw1.hopoff.acme.com

gk.hopoff.acme.com#show gatekeeper zone prefix
      ZONE PREFIX TABLE
      =====
GK-NAME          E164-PREFIX
-----
gk.hopoff.acme.com  *
```

GW Config—Hopoff

```
hostname gw1.hopoff.acme.com
!
aaa new-model
aaa authentication login default radius
aaa accounting connection h323 start-stop
radius
!
isdn switch-type primary-5ess
!
controller T1 0
framing esf
clock source line primary
linecode b8zs
pri-group timeslots 1-24
!
dial-peer voice 2 voip
incoming called-number 2.....
session target ras
precedence 5
Repeat until 9.....
!
dial-peer voice 1 pots
destination-pattern 2
port 0:D
prefix 12
Repeat until 9

gateway
!
interface Loopback0
ip address 10.10.249.1 255.255.255.0
h323-gateway voip interface
h323-gateway voip id gk.hopoff.acme.com ipaddr
10.10.253.10 1719
h323-gateway voip h323-id gw1.hopoff.acme.com
h323-gateway voip tech-prefix 1#
!
interface Ethernet0
ip address 10.10.253.5 255.255.255.0
no ip directed-broadcast
ntp broadcast client
!
interface Serial0:23
isdn switch-type primary-5ess
isdn incoming-voice modem
!
radius-server host 10.1.11.11 auth-port 1645
acct-port 1646
radius-server key testing123

gw1.hopoff.acme.com#sh gateway
Gateway gw1.hopoff.acme.com is
registered to Gatekeeper gk.hopoff.acme.com
```

GW Selection (GW CLI)

- Resource Availability Indicator (RAI)
- RAI almostOutOfResources=True/False sent to GK when resources (DS0) low/available
- GK places RAI=True GWs to bottom of GW selection list
- If all GWs in zone have RAI=True, GK will randomly assign calls based on configured priorities
- Specify the high- and low-resource marks

```
gw1.hopoff(config-gateway)#resource threshold all high 90 low ?  
<1-100> low threshold percentage value
```

DGK Configuration

```
hostname gk.directory.acme.com  
!  
interface Ethernet0/0  
 ip address 10.10.250.4 255.255.255.0  
 standby 1 priority 90  
 standby 1 ip 10.10.250.10  
!  
gatekeeper  
 zone local gk.directory.acme.com acme.com 10.10.250.10 1719  
 zone remote gk.west.acme.com 10.10.254.10 1719  
 zone remote gk.hopoff.acme.com 10.10.253.10 1719  
 zone remote gk.east.acme.com 10.10.252.10 1719  
 zone remote gk.central.acme.com 10.10.251.10 1719  
 zone prefix gk.west.acme.com 213*  
 zone prefix gk.east.acme.com 212*  
 zone prefix gk.central.acme.com 312*  
 zone prefix gk.central.acme.com 630*  
 zone prefix gk.hopoff.acme.com *  
 gw-type-prefix 1#* default-technology  
 lrq forward-queries  
 no shutdown
```

DGK Show Commands

```
gk.directory.acme.com#show gatekeeper zone prefix
      ZONE PREFIX TABLE
      =====
GK-NAME          E164-PREFIX
-----          -
gk.east          212*
gk.central       312*
gk.central       630*
gk.west          213*
gk.hopoff        *
```

Useful Debugs

- **Gateway Debugs**
 - debug h225 asn
 - debug h245 asn
 - debug q931
 - debug voip ccapi inout
 - debug ras
- **Gatekeeper Debugs**
 - debug h225 asn
 - debug ras

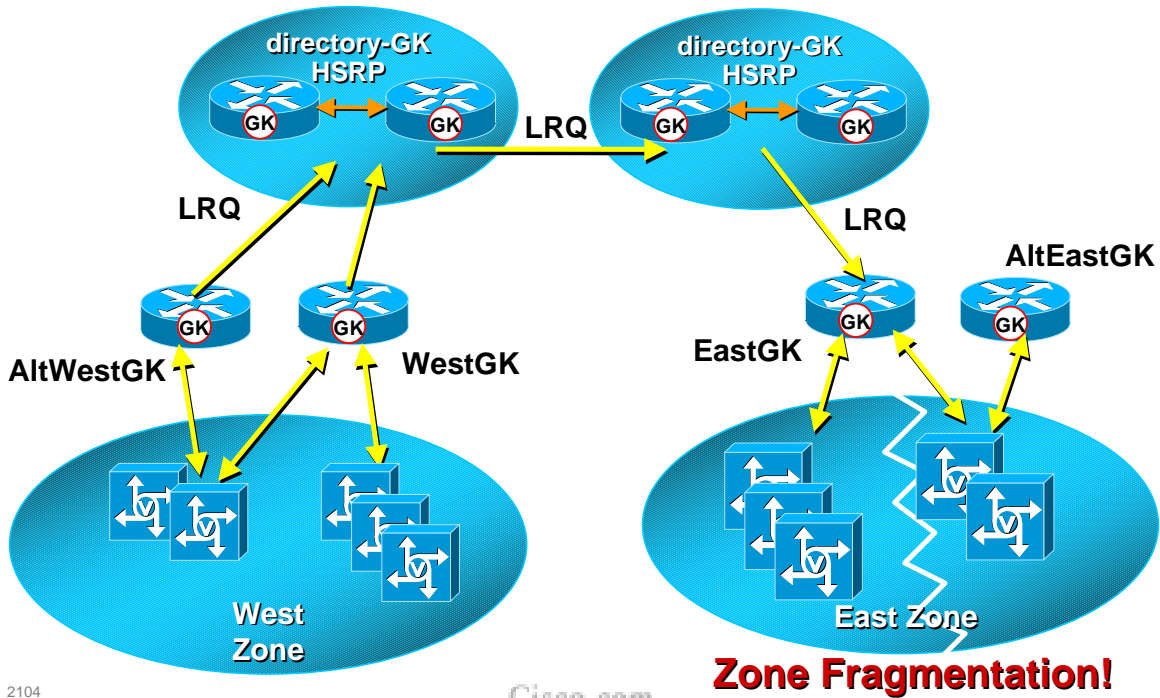
Topics

- Brief Introduction to H.323 and Applications
- Sample Network Scenario
- GK Performance
- **Alternate GK Discussion**
- Q & A

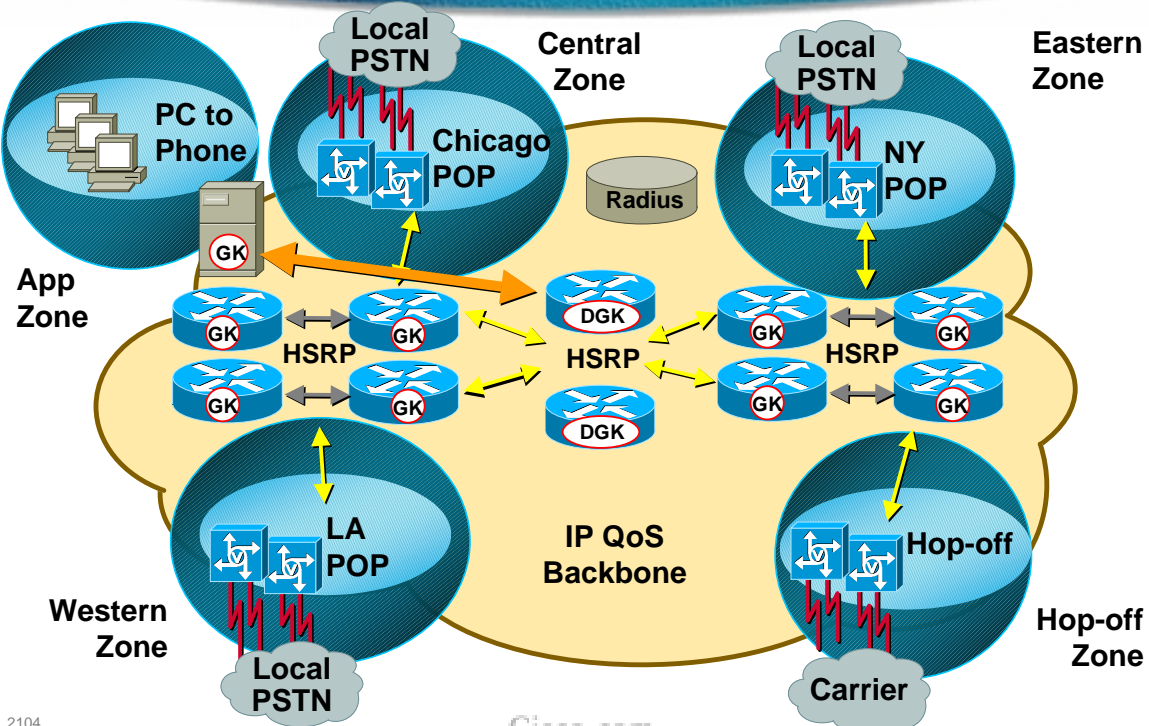
12.0(7)T Fault Tolerance

- **AltGK on Cisco GWs**
 - Static definition for two GKs as well as dynamic altGK lists from third-party AltGK partners
 - Geographically independent GK failover
- ```
Gateway(config)# h323-gateway voip gatekeeper-ID ip-address
priority number
```
- The priority range is 1 through 127, and the default value is 127.
- **Cisco GK still HSRP only**
    - Geographic colocation Of gks
    - Network unavailable during HSRP failover interval (up to 3 min.)
  - **Zone fragmentation if static AltGK used with Cisco GKs**

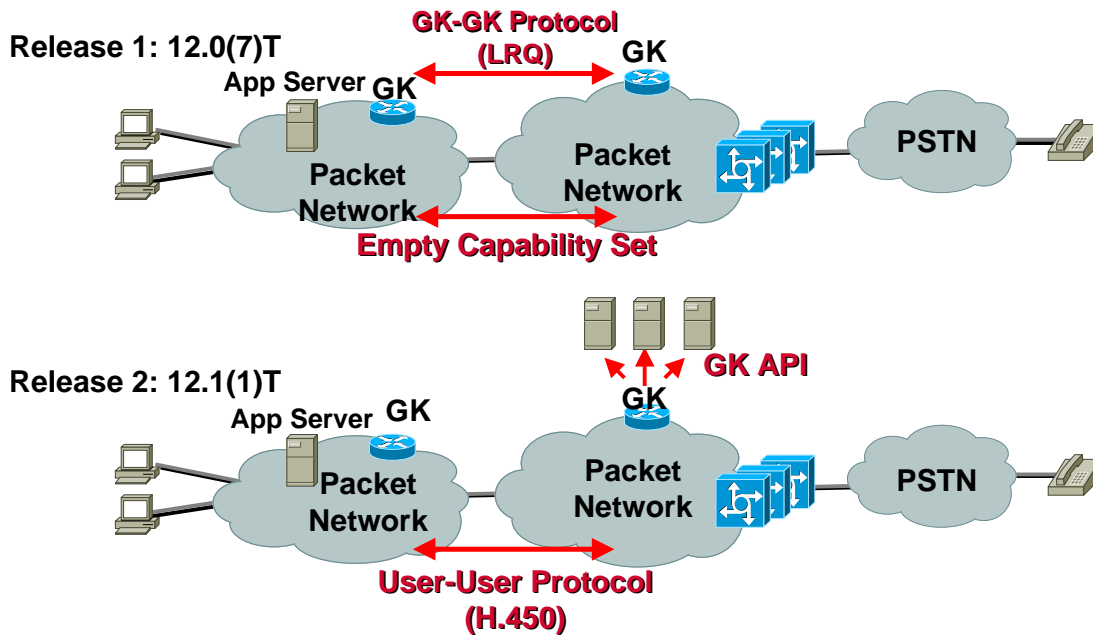
# AltGK Zone Fragmentation



# Adding Enhanced Services



# Application Zone Interfaces



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## Deploying Large Scale SP VoIP Network

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# Please Complete Your Evaluation Form

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54